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*RESEARCH PAPER*

# Effect of sources and levels of sulphur and bio-fertilizer on growth, yield and quality of summer groundnut

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**Abstract :** A field experiment was conducted during summer season of 2015 to study the effect of sources and levels of sulphur and bio-fertilizer on growth, yield and quality of summer groundnut (*Arachis hypogaea* L.) at Anand Agricultural University, Anand. The experiment was conducted in a loamy sand soil with 12 treatment combinations (2 source of sulphur, 3 levels of sulphur and 2 levels of bio-fertilizer). The study revealed that sources and level of sulphur as well as biofertilizer treatment significantly influenced all the yield attributing characters , pod and haulm yield. Sulphur applied @ 40 kg $ha^{-1}$ through gypsum recorded an increase in pod and haulm yield to the tune of 11.51 and 9.69 per cent, respectively over elemental sulphur.

**Key Words :** Groundnut, Gypsum, Oil content, Sulphur, Yield, Yield attributes

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## INTRODUCTION

Oilseeds constitute the second major agricultural crop in the country next to food grains in terms of tonnage and value. Groundnut is one of the most important and unique legume cum oilseed crop of India accounting 33 per cent of world's groundnut area and about 27.3 per cent production. It is world's largest source of edible oil and ranks 13$^{th}$ among the food crops as well as 4$^{th}$ most important oilseed crops of the world. Among the various factors known to determine the groundnut yield, balanced nutrition is considered as one of the basis factors which can increase production.

In oilseed crops, for especially production factor, fertilizer stands first and is considered one of the most productive or kingpin as well as costly inputs in the present system of agriculture. It is established that there is a positive correlation between fertilizer use and crop production. Sulphur is one of the key element required to produce protein, oil and flavored compounds as well as to ensure quality. Sulphur is very crucial for the formation of sulphur containing amino acids and oil synthesis. Deficiency of sulphur has been frequently observed due to a number of reasons like increased removal of sulphur by the crop, high yielding fertilizer responsive crop varieties, increased cropping intensity and extensive use of sulphur free fertilizers. Intensive cropping leads to deficiency of secondary nutrient which is also the main constrain for low yield of groundnut and

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for higher yield, optimum mineral nutrition is considered to be prime importance.

Sulphur is identified as a key element for increasing the production of oilseeds by increasing the uptake of various macro and micro nutrients in groundnut (Singh,1999).There are large numbers of sulphur sources available in the country and their efficiency in crops like groundnut needs to be evaluated. Inoculations with an effective sulphur oxidizing *Rhizobium* (SOR) strain increased yield as well as oil content of groundnut through convey the additional sulphur demand of plant by increasing the availability. Keeping in view the importance of these factors, the present study was designed to investigate the effect of sources and levels of sulphur and bio-fertilizer on growth, yield and quality of summer groundnut.

## MATERIAL AND METHODS

The present investigation was undertaken during the summer seasons of 2015 at college agronomy farm, Anand Agricultural University, Anand, Gujarat. The region is characterized by semi-arid and sub-tropical with hot and dry summer (late Feb. - third week of June), wet monsoon (late June- Sept.) and fairly cool, dry winter (Nov.- mid of February).The soil was loamy sand in texture having 0.38 per cent organic carbon, 150.48 kg available nitrogen, 30.28 kg available phosphorus, 350.30 kg available potassium, 6.2 ppm available sulphur. Experiment was laid out in Randomized Block Design (Factorial) with 12 treatment combinations. It consisted of two sources of sulphur $S_1$ (elemental sulphur), $S_2$ (gypsum), three levels of sulphur $L_0$ (control), $L_1$ (20 kg S $ha^{-1}$), $L_2$ (40 kg S $ha^{-1}$) and two levels of bio-fertilizer (Sulphur oxidizing *Rhizobium*), $R_0$ (without bio-fertilizer), $R_1$ (with bio-fertilizer). Groundnut variety "GJG 31" was sown at a spacing of 30 cm × 10 cm using seed rate of 120 kg $ha^{-1}$. A basal dose of 25 kg nitrogen and 50 kg phosphorus were applied in the form of urea and DAP, respectively. Sulphur was applied as basal dose in the form of gypsum and elemental sulphur, seed was treated with sulphur oxidizing *Rhizobium* at the rate of 5 ml per kg in the respective treatments. The oil content of the kernel was determined by NMRS method. The protein content was obtained by multiplying N content of kernel with 5.46. Ideal weather conditions prevailed during crop growth.

The observations on different parameters were recorded after harvest. Data collected on all parameters were analyzed statistically by using Fisher's analysis of variance technique and least significant difference (LSD) test at 5 per cent probability level was employed to compare the treatment means.

## RESULTS AND DISCUSSION

During the experimental period, different levels and sources of sulphur and bio fertilizer remarkably influenced on the growth, yield contributing characters, yield and oil content of groundnut (Table 1). Application of sulphur significantly increased the plant height. Addition of sulphur @ 40 kg $ha^{-1}$ through gypsum recorded the highest plant height compared to elemental sulphur. Increased growth components observed under gypsum might be by attributed to readily available sulphate form of sulphur, enhanced uptake of nutrients even at initial stages of crop growth. Poor response of elemental sulphur might be due to low oxidation rate of sulphide to sulphite and to sulphate form of sulphur. Similar findings were earlier reported by Rao *et al*. (2013) and Jawahar *et al*. (2013). There was no noticeable difference in plant height due to application of sulphur oxidizing *Rhizobium*.

Sulphur application had significant influence on all the yield attributing characters regardless of the sources and levels of sulphur application over control. Similar trend was observed as regards to application of bio-fertilizer. Application of sulphur at 40 kg $ha^{-1}$ noticeably increased all the yield contributing characters. Addition of sulphur @ 40 kg $ha^{-1}$ through gypsum with bio-fertilizer treatment recorded the highest number of branches and pods per plant. The increase in number of pods per plant might be due to the sulphur plays vital and important role in energy storage and transformation, carbohydrate metabolism and activation of enzymes also increase the photosynthetic activity of plant. These findings endorse the results of Kadam *et al*. (2000); Jamal *et al*. (2006); Kader and Mona (2013) and Ram and Katiyar (2013).

In comparison of both the sources of sulphur treatment, gypsum showed its superiority over treatment elemental sulphur in recording pod and haulm yields. Pod and haulm yield increased significantly with sulphur application irrespective of sources over control. Application of 40 kg S $ha^{-1}$ through gypsum recorded the highest pod and haulm yields compared to other source and levels of sulphur application. Magnitude of increase pod yield and haulm yield due to treatment gypsum was the tune of 11.51 and 9.69 per cent,

respectively over elemental sulphur. The better performance of this treatment might be due to higher solubility, nutrient availability and uptake resulting into increased yield attributes. Besides, this gypsum also provides Ca and mobilization of Ca from soil to the pod in groundnut crop takes place through the gynophores so the amount of Ca transported decides the pod yield. It also emphasized that Ca application also reduce the ovule abortion and enhanced pod development, thus, result in higher pod yields. The results are in agreement with those of Chaubey *et al*. (2000); Singh and Singhi (2000); Nayak *et al*. (2009); Giri *et al*. (2014) and Naiknaware *et al*. (2015). Similar trend was observed with application of bio fertilizer. Significantly the highest pod and haulm yields were achieved when seed was treated with sulphur oxidizing *Rhizobium* . Bio-fertilizer inoculation produced 5.62 per cent and 5.16 per cent higher pod yield and haulm yield, respectively over no bio-fertilizer inoculation. The results corroborate those achieved by Shinde and Jadhav (2000); Sakari *et al*. (2012) and Pujar *et al*. (2014).

Favourable effect of sulphur application was noticed on shelling per cent also where supply of sulphur at 40 kg $ha^{-1}$ improved shelling per cent while it was not significantly influenced by bio-fertilizer treatment. Sulphur application enhanced the oil content of the kernel significantly. Addition of sulphur @ 40 kg $ha^{-1}$ through gypsum registered the highest oil content over control. However, it was found statistically at par with application of 20 kg S $ha^{-1}$ through gypsum. The increase in oil content from gypsum was to the extent of 8.18 per cent over elemental sulphur. This might be due to involvement of sulphur directly in oil synthesis. Higher yield and oil content with increased application of sulphur also attributed protein and enzyme synthesis as it is a constituent of sulphur containing amino acids namely methonine, cysteine and cystine. The result is in conformity with findings of those reported by Bhagiya *et al*. (2005); Nasef *et al*. (2006); Rao *et al*. (2013) and Jawahar *et al*. (2013). Seed inoculated with bio-fertilizer did not produced significant variation over control in oil content of groundnut.

**Table 1: Effect of sources, levels of sulphur and bio-fertilizer on growth, yield and quality of groundnut**

| Treatments | Plant height (cm) | No. of branches $plant^{-1}$ | No. of pods $plant^{-1}$ | Pod yield (kg $ha^{-1}$) | Haulm yield (kg $ha^{-1}$) | Shelling (%) | Oil content (%) |
|---|---|---|---|---|---|---|---|
| **Sources of sulphur** | | | | | | | |
| $S_1$:Elemental sulphur | 24.97 | 7.93 | 16.21 | 2866 | 5655 | 59.98 | 46.31 |
| $S_2$: Gypsum | 26.21 | 8.49 | 17.21 | 3196 | 6203 | 64.43 | 50.10 |
| S.E.± | 0.43 | 0.16 | 0.32 | 57 | 100 | 1.19 | 1.11 |
| C.D.(P=0.05) | 1.23 | 0.46 | 0.92 | 164 | 289 | 4.42 | 3.21 |
| **levels of sulphur** | | | | | | | |
| $L_0$: control | 24.34 | 7.62 | 15.14 | 2586 | 5139 | 59.50 | 44.45 |
| $L_1$: 20 kg S $ha^{-1}$ | 25.76 | 8.20 | 16.76 | 3142 | 6159 | 63.27 | 48.86 |
| $L_2$: 40 kg S $ha^{-1}$ | 26.67 | 8.81 | 18.22 | 3365 | 6489 | 64.85 | 51.48 |
| S.E.± | 0.52 | 0.19 | 0.39 | 70 | 123 | 1.45 | 1.39 |
| C.D.(P=0.05) | 1.51 | 0.57 | 1.12 | 200 | 354 | 4.19 | 4.00 |
| **Bio-fertilizer** | | | | | | | |
| $R_0$:Without bio-fertilizer | 25.17 | 7.96 | 16.17 | 2948 | 5780 | 61.37 | 47.04 |
| $R_1$: With bio-fertilizer | 26.01 | 8.46 | 17.24 | 3114 | 6078 | 63.05 | 49.36 |
| S.E.± | 0.43 | 0.16 | 0.32 | 57 | 100 | 1.19 | 1.11 |
| C.D. (P=0.05) | NS | 0.46 | 0.92 | 164 | 289 | NS | NS |
| C.V. (%) | 8.20 | 9.67 | 9.37 | 9.18 | 8.30 | 9.37 | 11.34 |

NS= Non-significant

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